A NOTE ON THE FISHES OF LAKE JIPE AND LAKE CHALE ON THE KENYA-TANZANIA BORDER

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Lake Jipe is a shallow basin at about 3° 40' S 37° 40' E, east of the North Pare Mountains in Tanzania. Chala is a smaller lake lying in a rocky crater about 19 km north of Lake Jipe. In 1951, when it was visited by Dr. Lowe-McConnell (then Miss R.H. Lowe) Lake Jipe was about 12 miles (19 km) long and 1.5 miles (2 km) wide and only a few feet deep. Its northern end is a swamp into which flows a stream, known in Kenya as the Lumi, from Mount Kilimanjaro. From its northwestern end issues, at least in wetter periods, the River Ruvu[4] headwater of the long river formerly known by that name, but now called the Pangani, the name of the town at its mouth on the Indian Ocean. Since the formation of the barrage lake Nyumba ya Mungu (NYM) in the upper Pangani the Ruvu flows from Lake Jipe into the swampy north-east corner of this lake. Lake Jipe's swampy edges are surrounded by semi-aquatic grasses and reeds, and patches of water-weeds (*Najas* and *Potamogeton*) spread their leaves and flowers on its surface. Numerous water birds prey on the lake's fauna and these and hippopotamus fertilize the water. The sketch by Sir Harry Johnston, reproduced here from his book of 1886, gives an idea of the lake's appearance as it remains today, (Fig. 1).

At Taveta, NE of Lake Jipe, the well-known pioneer Colonel E.S. Grogan had settled after the Second World War and established a farm including fish-ponds stocked from Lake Jipe. Lake Jipe and Chala and the Taveta ponds were visited in 1951 by Miss Lowe, who was then a member of the East African Fisheries Research Organisation at Jinja, Uganda. She collected fishes from the ponds and both lakes. The two tilapiine species of Lake Jipe proved to have been undescribed. She then travelled on to Korogwe[5] on the Lower Pangani, where Major R.E. Gould, then fish culturist to the Tanganyikan (Tanzania) Government, had established fish-ponds in which he reared tilapiine species preparatory to using them for stocking dams and ponds. Among his species were the two endemic tilapias from lake Jipe and two from the River Pangani and these were the subject of Lowe's paper of 1955, where they were named *Tilapia jipe* and *T.girigan* (Lake Jipe) and *T.pangani* and *T.mossambica korogwe* (River Pangani). The last named was later given full specific status by Trewavas (1983) and all four were included in the genus *Oreochromis*. The generic name *Oreochromis* had been proposed for *O.hunteri* by Gunther in 1889, a name meaning 'mountain Chromis' in reference to its habitat in Lake Chala on the slopes of the Kilimanjaro volcanic mass. (Chromis is a name that had been used for several cichlids, but really belongs to a marine genus.)

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[4] The Ruvu of Bailey et al., 1987, not of Bailey, 1969. The latter is also known as the Kingani and enters the Indian Ocean at Bagamoyo.
[5] Not the Korogwe at the entry of the Ruvu to NYM (Bailey et al., 1978)

The situation in 1951 and until recently was therefore that Lake Chala contained one endemic tilapiine species, *O.hunteri*, and Lake Jipe two, *O.jipe* and *O.g.girigan*. Lowe (1955) recognised that fry of *O.girigan* were difficult to distinguish from *O.pangani* and Trewavas (1983) considered these two forms to be only subspecifically distinct.

One of us (R. Haller), has, since May 1976, been taking *Oreochromis* from Lake Jipe for culture at Baobab Farm, near Mombasa. In January 1983 a third tilapiine species was found in the Lake and a brood of young about 2.5cm long was taken to Boabob Farm and reared to maturity which they reached at an age of 9 months and a total length of 16-18 cm. A sample of these, five of each sex, was sent to the British Museum (Natural History) [BMNH] and identified as *Oreochromis esculentus* (Graham).

Another of us (S. Dadzie) visited the lakes in March-April, 1985, and found in Lake Jipe, as well as the two endemic *Oreochromis* and *O.esculentus* several specimens of *Tilapia rendalli* Boulenger. From Lake Chala he collected *T.rendalli* and a large specimen of *O.p.pangani*, as well as the endemic *O.hunteri*.

We have no doubt that *O.esculentus*, *Tilapia rendalli* and *O.p.pangani* were introduced to these lakes from the Tanzania side, either deliberately or in the case of Lake Jipe by migration up the Ruvu River. The first two are not native to the area and no tilapine except *O.hunteri* was previously known from Lake Chala although this species had been collected there and specimens sent to the BMNH on five occasions, registered in 1889, 1902, 1946, 1952 and 1980.

Non-tilapiine fishes also present in Lake Jipe in 1951 (Lowe, 1951) were *Astatotilapia bloyeti* (Sauvage), *Clarias mossambicus* Peters, *Barbus paludinosus* Peters and *Petersius tangensis* Lonnberg. *Astatotilapia bloyeti* was found also in Lake Chala by W.P. Scott in 1977 and again by Dadzie in 1985.

Specimens of the introduced species and the non-tilapiines were sent to the BMNH and identified by E.T.

The Introduced Species

Gould (1951) published a list of the species that he had imported for culture to Korogwe. Among them were*O.esculentus* and*O.variabilis*, species endemic in the Lake Victoria basin, and *Tilapia rendalli*[6] and *O.macrochir* from ponds in Katanga (now Shaba).

O.esculentus is a mouth-brooder, now common in several dams and lakes in Tanzania, including Nyumba ya Mungu (see Bailey et al., 1987 and Trewavas, 1983), which probably acquired it from stocked ponds and backwaters in the flooded area. For food it has a strong preference for phytoplankton in open waters. This was shown by observation in its original habitat, the Lake Victoria basin (for references see Trewavas, 1983), in experimental ponds Payne, 1971) and in Nyumba ya Mungu (Bailey et al. 1978). Its weak jaws and minute teeth are unsuited either for

[6]Referred to as *T. melanopleura*, a name no longer in use.

scraping algal growths from stems and leaves or for biting and chewing higher plants. In NYM, although it succeeded in establishing itself as a proportion of the tilapiine fauna, its growth in length was inferior to that of the species of local origin (*O.p.pangani* and *O.jipe*) and also to that in its original habitat. In NYM very few specimens exceeded 22 cm in total length and 350 g in weight, whereas males of *O.jipe* and *O.p.pangani* grew to between 32 and 38 cm with a maximum weight of 1800 g (Bailey et al., 1978, figs 3 & 4). A male *O.esculentus* collected from NYM in 1980 by A.I. Payne was nearly ripe at TL 17 cm; this is about the same as the length of mature fishes reared at Baobab Farm for 9 months (16-18 cm) and that recorded by Lowe (1955) in ponds at Korogwe (16-19 cm at an age of under 7 months). In Lake Victoria the minimum length at first maturity was recorded as 19 or 20-21 cm at different localities, but most do not breed until they are 22 cm or more in total length (Lowe-McConnell; 1956, Garrod, 1959). They go on to reach TL of 30 cm or more.

Tilapia rendalli, a substrate-brooder and guarder of the young, is one of the largest of its genus. It is a voracious feeder on aquatic and semi-aquatic higher plants. Ruwet (1962 and 1963) gives a vivid descriptions of its feeding in the barrage Lake Mwadingusha in the course of River Lufira, Shaba. The lake was shallow, mostly less than 4 metres maximum depth, and in dry seasons or when the rains were deficient the draw-down at the electric power station was so great that the lake shrank to a fraction of its maximum area and semi-aquatic vegetation was able to intrude over vast stretches. When rain again flooded the lake *T.rendalli* immediately attacked flooded grasses. Ruet describes the event as follows (translation from the account of 1963):

> "I have often halted in a canoe in the middle of the immense meadows dominated by *Oryza*, the wild rice. I still remember the continuous cracking sound produced by hordes of *(T.rendalli)* tearing, cutting and browsing on the flooded stems, leaves and rhizomes of *Oryza*. From mid-March, under the joint activity of thousands of these fishes, the edge of the meadows from Kinshasha to Shinangwa, that is, over a distance of about 15 Km, retreated by about 8-10 metres".

Dr G.B. Bernascek, in a letter dated 24.VI.1980 reported that the introduction in 1951 of *T.rendallia* to a densely vegetated lagoon near the mouth of River Lupululu in southern Tanzania had resulted in its clearance to form a lake of open water.

Such are the two species now introduced into Lake Jipe.

The Endemic Tilapiines

What is known of the ecology of the original inhabitants is due to Lowe (1955) and Bailey et al. (1978). They are mouth-brooders, with a characteristic form of nest (mating territory). Stomachs of *O.p.girigan* from Lake Jipe contained fragments of water-lily plants and epiphytic algae from *Najas* stems and leaves. The coarse teeth of this species are well suited to such a diet. Lowe's few specimens of *O.jipe* from Lake Jipe did not provide information about its natural food. In the Korogwe was restricted to ponds both this and *O.p.girigan* fed on detritus, but *O.jipe*, finer particles a difference corresponding to the difference between them in the pharyngeal dentition. In NYM both *O.jipe* and the indigenous *O.p.pangani* fed on periphyton.

The Future of Lake Jipe

One of us (S. Dadzie) has embarked on a study of the reproductive regimes of the two endemic species of Lake Jipe and their ecological relationships. The problem that now faces him is more complex, involving the impact of the introduced species on the endemics.

If *O.esculentus* is shown to feed on phytoplankton in L.Jipe, this will remove it from competition with either *O.jipe* or *O.p.girigan*. In Lake Victoria, before the decline of tilapia fisheries, *O.esculentus* was favoured as food over the sympatric species *O.variabilis*, both for the quality of its flesh and for its ability to grow to a good marketable size, qualities that were no doubt the result of its abundant and rich planktonic diet.

There is evidence however that by 1980 in Nyumba ya Mungu. *O.esculentus* was breeding at a small size and failing to achieve it full growth potential. In 1974 *O.esculentus* comprised 24% of all the tilapiines in the commercial catch (Bailey et al., 1978:122). By 1980 this species constituted the major part of the catch, even in the shallow northern part of the lake; but those measured did not exceed 17.5 cm in total length and many of them were sexually mature (A.I.Payne, personal comm and in press).

Dwarfing of *O.esculentus* in Lake Jipe would endanger the endemic species, because nets of mesh small enough to catch adults of *O.esculentus* would probably catch *O.jipe* and *O.p.girigan* before they had reached sexual maturity.
O.esculentus may also compete with the native species for breeding sites. These are at present unknown and difficult to find in the opaque waters of Lake Jipe. Their presence in a locality may be inferred by the concentration of males in breeding condition. Nursery sites may similarly be located by the predominance of brooding females.

Tilapia rendalli and *O.p.girigan* may occupy the same, rather specialized, trophic niche. A relevant question is, do they sub-divide this niche? For instance, does one species favour floating plants while the other uses grasses in the swamps? Their enemies in Lake Jipe are the birds and the catfish *Clarias gariepinus* with which all species must take their chance together.

Finally, the two introduced species in Lake Jipe may prove to be successful competitors with the local species, *T.rendalli* by competition for food and *O.esculentus* by its strategy of progenesis and dwarfing, and possibly both by competition for breeding sites. There is danger that these may oust the native tilapias, providing instead an abundant but small *O.esculentus* and a *Tilapia rendalli* the quality of which cannot be assumed to exceed or even equal that of *O.p.girigan*.

The Fishery

Lake Jipe supports a considerable fishery. Ninety-six fishermen are registered and 56 of them fish regularly. Dugout canoes are the only crafts used and gillnets of stretched mesh 2" to3.5" are set, made of nylon thread of 2,3 or 4 ply. The usual catch consists of tilapiines and some *Clarias*. The same species are caught by hook and line, using hooks of sizes 14, 16 and 18. Traditional traps (migono) are set at the shallow edges of the lake and catch all species, including a haplochromine.

Sardine traps, also set at the shallow edges, catch exclusively the small *Petersius* ("sardines") that form schools in the lake (Information from the Kenya Fisheries Department). At the smaller but deeper Lake Chala there are 7 registered fishermen of whom 2 operate regularly.

Fishing in both lakes is for marketing as well as for subsistence. The fields are therefore of legitimate concern, and a factual knowledge about these resources is relevant to the economy of the local people as well as to science.

Pond culture

The experience at Taveta of the Late Colonel Grogan and now at Baobab Farm demonstrates the suitability of the endemic species of Lake Jipe for pond culture. *Tilapia rendalli* has been used in ponds, lagoons and dams both for clearing excess vegetation and as a food fish. Both this and *Oreochromis p.girigan* feed naturally on macrophytes. As Payne (1971) showed with *Tilapia zillii* at Malya (75 miles south of Lake Victoria) plant eaters can efficiently use waste from crops. The problem with *Oreochromis esculentus* in ponds is that it fails to grow as well as in L.Victoria. Payne (1971) found that the growth of *O.esculentus* virtually ceased until he fertilized the pond with ammonium sulphate, to promote a bloom of phytoplankton. This resulted in the resumption of growth. The experiments covered only seven months, however, and the maximum total length of *O.esculentus* at the end of this period was 20 cm, weight 140 g (mean 17 cm and 75 g); and some reproduction was taking place.

In L. Victoria Lowe-McConnell (1956) estimated a growth in length to 14-17 cm for *O.esculentus* in the first year and Garrod's (1959) estimates were in agreement. In ponds and probably in Lake J.[illegible], growth is brought to a halt by the onset of sexual maturity, which in Lake Victoria is delayed until the age of 2 or 3 years and a length usually of 22 cm or more. Thus the challenge for pond culturists of this species is the familiar one with tilapias - how to delay sexual maturity. This may be done either by design of ponds to discourage territory-establishement by males (Balarin & Haller, 1983) or by hormonal treatment to produce 100% males by sex-reversal of the females. Both methods require specialist skills and capital investment. For a summary see Mires, (1983:600-610).

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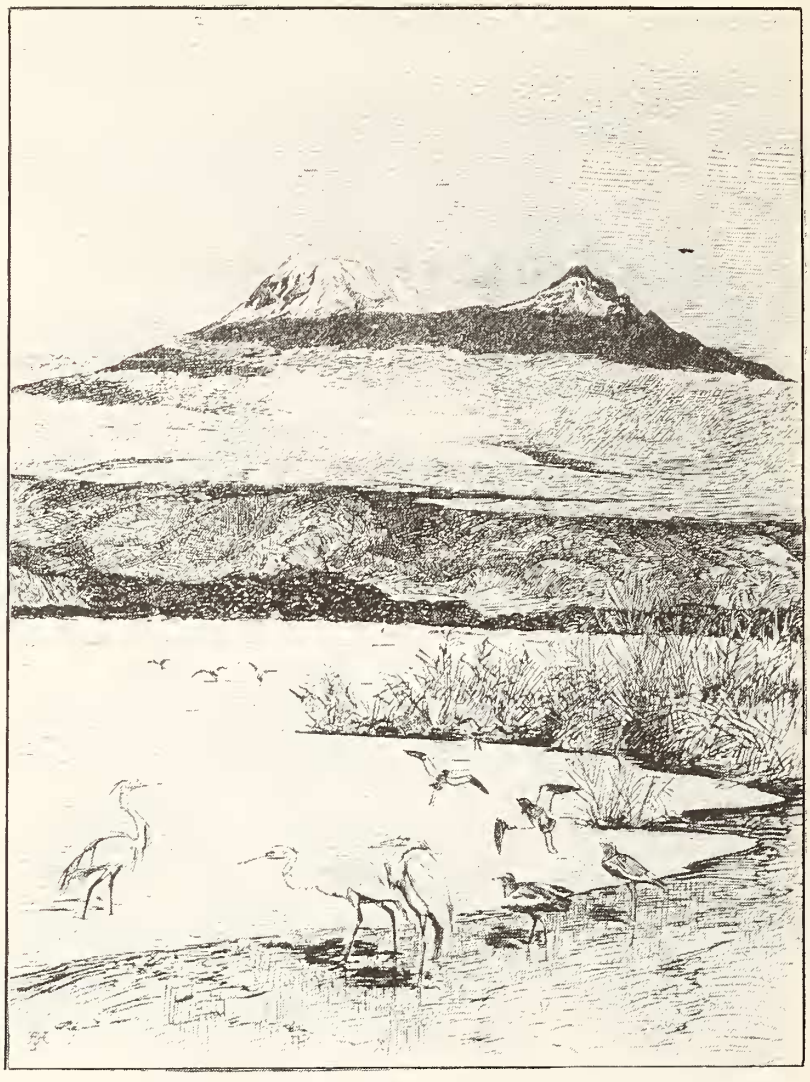

Fig. 1. Lake Jipe. From a sketch by Sir Harry Johnston in his book The Kilima-Njaro Expedition (1886).